

PATENT COOPERATION TREATY

PCT

INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY

(Chapter II of the Patent Cooperation Treaty)

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference P/2360.WO/CJW	FOR FURTHER ACTION	
	See Form PCT/IPEA/416	
International application No. PCT/EP2004/007161	International filing date (day/month/year) 01.07.2004	Priority date (day/month/year) 03.07.2003
International Patent Classification (IPC) or national classification and IPC H01L21/68, H01L21/58		
Applicant XSIL TECHNOLOGY LIMITED et al.		

1. This report is the international preliminary examination report, established by this International Preliminary Examining Authority under Article 35 and transmitted to the applicant according to Article 36.
2. This REPORT consists of a total of 6 sheets, including this cover sheet.
3. This report is also accompanied by ANNEXES, comprising:
 - a. (*sent to the applicant and to the International Bureau*) a total of 4 sheets, as follows:
 - sheets of the description, claims and/or drawings which have been amended and are the basis of this report and/or sheets containing rectifications authorized by this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions).
 - sheets which supersede earlier sheets, but which this Authority considers contain an amendment that goes beyond the disclosure in the international application as filed, as indicated in item 4 of Box No. I and the Supplemental Box.
 - b. (*sent to the International Bureau only*) a total of (indicate type and number of electronic carrier(s)), containing a sequence listing and/or tables related thereto, in computer readable form only, as indicated in the Supplemental Box Relating to Sequence Listing (see Section 802 of the Administrative Instructions).

4. This report contains indications relating to the following items:
<input checked="" type="checkbox"/> Box No. I Basis of the opinion <input type="checkbox"/> Box No. II Priority <input type="checkbox"/> Box No. III Non-establishment of opinion with regard to novelty, inventive step and industrial applicability <input type="checkbox"/> Box No. IV Lack of unity of invention <input checked="" type="checkbox"/> Box No. V Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement <input type="checkbox"/> Box No. VI Certain documents cited <input type="checkbox"/> Box No. VII Certain defects in the international application <input type="checkbox"/> Box No. VIII Certain observations on the international application

Date of submission of the demand 03.05.2005	Date of completion of this report 10.11.2005
Name and mailing address of the international preliminary examining authority:  European Patent Office - Gitschner Str. 103 D-10958 Berlin Tel. +49 30 25901 - 0 Fax: +49 30 25901 - 840	Authorized Officer Favre, P Telephone No. +49 30 25901-772



**INTERNATIONAL PRELIMINARY REPORT
ON PATENTABILITY**

International application No.
PCT/EP2004/007161

IAP20 Rec'd IPEA/PCTO 23 DEC 2005

Box No. I Basis of the report

1. With regard to the **language**, this report is based on the international application in the language in which it was filed, unless otherwise indicated under this item.
 - This report is based on translations from the original language into the following language, which is the language of a translation furnished for the purposes of:
 - international search (under Rules 12.3 and 23.1(b))
 - publication of the international application (under Rule 12.4)
 - international preliminary examination (under Rules 55.2 and/or 55.3)
2. With regard to the **elements*** of the international application, this report is based on (*replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report*):
 - a sequence listing and/or any related table(s) - see Supplemental Box Relating to Sequence Listing

Description, Pages

1-7 as originally filed

Claims, Numbers

1-24 received on 03.05.2005 with letter of 03.05.2005

Drawings, Sheets

1/1 as originally filed

- a sequence listing and/or any related table(s) - see Supplemental Box Relating to Sequence Listing

3. The amendments have resulted in the cancellation of:
 - the description, pages
 - the claims, Nos. 25
 - the drawings, sheets/figs
 - the sequence listing (*specify*):
 - any table(s) related to sequence listing (*specify*):

4. This report has been established as if (some of) the amendments annexed to this report and listed below had not been made, since they have been considered to go beyond the disclosure as filed, as indicated in the Supplemental Box (Rule 70.2(c)).
 - the description, pages
 - the claims, Nos.
 - the drawings, sheets/figs
 - the sequence listing (*specify*):
 - any table(s) related to sequence listing (*specify*):

* If item 4 applies, some or all of these sheets may be marked "superseded."

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Box No. V Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Yes: Claims	1-24
	No: Claims	
Inventive step (IS)	Yes: Claims	
	No: Claims	1-24
Industrial applicability (IA)	Yes: Claims	1-24
	No: Claims	

2. Citations and explanations (Rule 70.7):

see separate sheet

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Re Item V

Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Reference is made to the following documents:

D1: EP-A-0 359 373 (LINTEC CORP) 21 March 1990,
 D2: WO 03/049164 A (KITAMURA MASAHIKO ; KIMURA YUSUKE (JP);
 YAJIMA KOICHI (JP); DISCO CORP) 12 June 2003 & US 2004/048419
 (KITAMURA ET AL) 11 March 2004.

2. **Inventive Step Objection - Article 33(3) PCT**

The present application does not meet the requirements of Article 33(3) PCT, because the subject-matter of **claims 1 to 24** lacks an inventive step.

2.1 Referring to independent **claim 1**, document D1, which is considered to represent the most relevant state of the art, discloses (the references in parenthesis refer to D1) a method of die bonding comprising the steps of:

- a) providing a structure comprising a wafer substrate (A in Fig. 2, claim 2 and page 5, lines 17-27) separated from a carrier base means (2 in Fig. 2) by an adhesive layer adhered to the carrier base means by a first adhesive (3 in Fig. 2);
- b) machining through the wafer substrate and through the adhesive layer no more than at most to scribe the carrier base means to form a singulated die with an attached singulated adhesive layer (Fig. 3 and page 5, lines 28-31);
- c) curing the structure to release the attached singulated adhesive layer from the carrier base means by curing the first adhesive (page 5, lines 37-42);
- d) picking and placing the die and attached singulated adhesive layer on a die pad (page 5, lines 32-42; page 5, lines 51-58; page 6, lines 7-14 and Fig. 5-7); and
- e) curing the attached singulated adhesive layer to adhere the die to the die pad (page 6, lines 7-14).

The method of claim 1 differs from that of document D1 in that the dicing step (step b) is carried out by laser machining. In the method of D1 only "by a suitable dicing means such as a dicing saw" is mentioned (page 5, line 29).

The problem to be solved by the present invention may therefore be regarded as to provide an alternative, effective way of dicing.

The skilled person in the field of semiconductor dicing knows that laser machining would provide an effective solution for dicing both a wafer and adhesive layer(s) between the wafer and a carrier base, see for example, in the same field, document D2 using equally a dicing saw or laser machining, page 3, paragraph 50 to page 4, paragraph 59; page 4, paragraph 75).

As a consequence, claim 1 is not allowable under Article 33(3) PCT for lack of inventive step of its subject-matter.

- 2.2 The same argumentation can be applied to the correspondent apparatus of **claim 16**, therefore claim 16 is not allowable under Article 33(3) PCT for lack of inventive step of its subject-matter.
- 2.3 The additional features introduced by dependent **claims 4, 5, 13, 19, 20, 23** are disclosed in document D1:
 - a) claims 4 and 19: claim 3 in D1,
 - b) claims 5, 13, 20 and 23: claim 2 in D1.

The additional features introduced by dependent **claims 2, 3 and 17** are disclosed in document D2, see paragraph 75.

- 2.4 Dependent **claims 6-12, 14, 15, 18, 21, 22 and 24** do not appear to contain any additional features which, in combination with the features of any claims to which they refer, meet the requirements of the PCT with respect to inventive step. The additional features are merely one of several straightforward design options from which the skilled person would select, in accordance with circumstances and without the exercise of inventive skill, in order to solve the problems posed, coming thus to the

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subject-matter of said claims.

Claims 2-15 and 17-24 are therefore not allowable for lack of inventive step of their subject-matter, Article 33(3) PCT.

3. All claims 1 to 24 meet the requirements of industrial applicability of Article 33(4) PCT.

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CLAIMS

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1. A method of die bonding comprising the steps of: providing a structure (10) comprising a wafer substrate (11) separated from carrier base means (13) by an adhesive layer (12) adhered to the carrier base means by a first adhesive; laser machining through the wafer substrate and through the adhesive layer no more than at most to scribe the carrier base means to form a singulated die (15) with an attached singulated adhesive layer (12); curing the structure to release the attached singulated adhesive layer from the carrier base means by curing the first adhesive; picking and placing the die and attached singulated adhesive layer on a die pad; and curing the attached singulated adhesive layer to adhere the die to the die pad.
2. A method as claimed in claim 1, wherein the step of laser machining comprises laser machining the wafer substrate (11) using a first laser beam (31) with a first machining profile of selected laser pulse power, laser pulse repetition rate, laser pulse width, laser beam scanning speed and laser wavelength; using a second laser beam (32) with a second such machining profile to machine the adhesive layer (12) and using a third laser beam (33) with a third such machining profile to machine the carrier base means (14) such that a speed of machining is maximised while providing a predetermined quality of singulated dies without substantial delamination of the adhesive layer and the carrier base means or substantial production of burrs.
3. A method as claimed in claim 2, wherein at least two of the first machining profile, the second machining profile and the third machining profile are a same machining profile.
4. A method as claimed in any of the preceding claims, wherein the step of curing the structure (10) comprises curing with ultraviolet light.
5. A method as claimed in any of the preceding claims, wherein the step of curing the attached singulated adhesive layer (12) comprises heat curing the adhesive layer.
6. A method as claimed in any of the preceding claims, wherein the step of machining the wafer substrate comprises machining a blind via (14) in

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the wafer substrate (11) or a via through the wafer substrate (11) and a die attach film (12).

7. A method as claimed in any of the preceding claims, wherein the step of laser machining includes a further step, after laser machining, of washing the structure to remove accumulated laser machining debris from the singulated die (15).
8. A method as claimed in claim 7, wherein the step of providing a structure comprises providing a structure having a protective film to protect the structure from debris produced during laser machining and the step of washing the structure comprises removing the protective film and accumulated debris thereon.
9. A method as claimed in any of the preceding claims, wherein the step of providing a structure comprises providing a structure having a wafer substrate (11) less than 800 microns thick.
10. A method as claimed in any of the preceding claims, wherein the step of laser machining comprises providing an assist gas environment for laser machining.
11. A method as claimed in claim 10, wherein the step of providing an assist gas environment comprises providing a gas environment in which photo-dissociation produces active radicals.
12. A method as claimed in claims 10 or 11, wherein the step of providing a gas environment reduces deposition of solid machining debris around a laser-machining site.
13. A method as claimed in any of the preceding claims, wherein the carrier base means is one of: a dicing tape, an inflexible tape suitable for thin wafer dicing or backgrinding; and a glass or other transparent solid.
14. A method as claimed in any of the preceding claims, wherein the step of providing a structure comprises providing a structure including a wafer substrate separated facedown from substantially inflexible transparent backgrinding tape means by the adhesive layer and the step of laser machining is performed subsequent to backgrinding the wafer substrate.

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15. A method as claimed in any of the preceding claims, wherein the step of picking and placing the die and attached singulated adhesive layer comprises picking and placing the die and attached singulated adhesive layer on another die to form a multistack die package.
16. A die bonding apparatus comprising: laser machining means arranged for machining a wafer substrate (11) and an adhesive layer attached (12) to the wafer substrate and to carrier base means (13) by a first adhesive and for no more than at most scribing underlying carrier base means (13) to form a singulated die with a singulated adhesive layer (15); first curing means arranged for curing the first adhesive to release the singulated adhesive layer (12) from the carrier base means (13); pick and place means arranged for picking the singulated die and adhesive layer (15) from the carrier base means (13) and placing the singulated die and adhesive layer (15) on die pad means and second curing means arranged for curing the singulated adhesive layer (12) of the singulated die to adhere the singulated die to the die pad means.
17. A die bonding apparatus as claimed in claim 16, wherein the laser machining means comprises: laser source means arranged for providing a pulsed laser beam (31, 32, 33); laser beam scanning means; and control means arranged for controlling at least one of laser pulse energy, laser wavelength, laser repetition frequency, laser pulse width, laser beam scanning speed and a number of scans by the pulsed laser beam.
18. A die bonding apparatus as claimed in claim 17, wherein the laser machining means further comprises memory means for storing a machining profile of at least one of laser pulse energy, laser wavelength, laser repetition frequency, laser pulse width, laser beam scanning speed and a number of scans by the pulsed laser beam, for use by the control means.
19. A die bonding apparatus as claimed in any of claims 16 to 18, wherein the first curing means comprises ultraviolet curing means.
20. A die bonding apparatus as claimed in any of claims 16 to 19, wherein the second curing means comprises heat curing means.

21. A die bonding apparatus as claimed in any of claims 16 to 20, including washing means arranged for washing laser machining debris from the singulated die.
22. A die bonding apparatus as claimed in claim 21, wherein the wafer substrate is provided with a protective film to protect the wafer substrate from laser machining debris, and the washing means is arranged to remove the protective film from the singulated die.
23. A die bonding apparatus as claimed in any claims 16 to 22, adapted for carrier base means which is one of: a dicing tape, an inflexible tape suitable for thin wafer dicing or backgrinding; and a glass or other transparent solid.
24. A die bonding apparatus as claimed in any claims 16 to 22, adapted for machining a structure comprising a wafer substrate separated facedown from substantially inflexible transparent backgrinding tape means by the adhesive layer.